

July 11, 2012

EXHIBIT NO.

164

To: City of Sammamish Planning Commission
From: Eugene B. Welch, Limnologist
Subjects: Erosion protection overlays and trends in water quality

There is an assumption that Lake Sammamish water quality (WQ) will be protected if erosion controls during construction recommended in the WADOE 2003 guidelines are followed, and that the current erosion protection overlays instituted originally by King County are no longer needed (statement by Robert Edwards, GFK Consulting, 5/17/12). That assumption is not supported by the evidence.

First of all, Lake Sammamish WQ is determined by runoff from developed and undeveloped land over the long-term, not only during construction. Further, phosphorus (P) is the key to algae abundance (including blooms of toxic species) and summer water transparency, not only storm water turbidity (and certainly not pH) during construction. The assumption by Mr. Edwards was that Lake Sammamish WQ would be protected if turbidity and pH were controlled during construction. There was no recognition of erosion problems often caused by increased runoff rate from impervious surfaces on steep slopes after construction is complete, nor of the importance of P. For example, the 1 m down cutting over ten years in a stream draining the west side of the Timberline area was caused by increased runoff, despite the presence of a detention basin, as observed and published by Prof. Derek Boothe and colleagues (see my June 1 letter). That eroded material contains P and is one of the reasons runoff from developed land typically contains ten times more P than runoff from forest. This long-term, insidious effect of development is the process that went into the predictions of effects of continued development on Lake Sammamish WQ summarized in my first written statement to the Planning Commission (3/28/12). Mr. Edward's statement did not consider this process or refer to any results of such studies.

The other important and directly related consideration, in the context of the present erosion protection overlays, is the continued high quality (17-foot transparency) of Lake Sammamish over the past 15 years (see my letter 4/29/12). That has been due, in part at least, to instituting the King County recommendations on watershed land use agreed upon in 1996. They included forest retention and 50% P removal in runoff from new development. According to Mr. Edward's statement, the erosion protection overlays were also instituted at about the same time by King County with the intent of protecting the water quality of Lake Sammamish. Apparently these protections have worked, as indicated by the continued high quality of the lake. Therefore, to insure the future high quality of the lake, the erosion protection overlays should remain in place in the new critical areas ordinance.

Analysis of Lake Sammamish water quality was presented to the Planning Comm. on 6/28/12 by Mr. Rob Zisette, Herrera Consulting. That analysis concluded that water quality, indicated by annual, whole-lake Total P (TP), had actually increased since 1994. That is, TP had significantly decreased, and that decrease was despite an increase in

urban development of about 12% on the westside and 15% on the eastside. Actually, whole lake TP did not decrease substantially in 2009-2011, as shown on Mr. Zisette's figure, because a calculation error was found in King County's data on July 10. The average for those years is 17 rather than 14. Thus, the difference between 1981-1994 and 1995-2011 is slight and not significant (see Table).

There were no calculation errors in summer TP, so Mr. Zisette's analysis showed no change in the trophic state index (TSI) that includes TP and its dependent chlorophyll and transparency. Storm water, usually warmer than the lake, enters the surface water and would have affected epilimnetic TP, which has been rather stable, averaging 12 ppb over the past 30 years (see Table). Nevertheless, one can conclude that lake water quality has not worsened with increased development. That fact supports continuing the same restriction on development that began with the King County recommendations and were approved by all parties in 1996. Even these restrictions are not fully protective, because storm water from the west side contained 100+ ppb TP and 50% removal in wet retention ponds still leaves 50+ ppb entering the lake's surface water that contains between 17 and 12 ppb, on average (see my 3/28 letter).

The real decreasing trend in TP has been in the hypolimnion, as a result of decreased release of P from bottom sediments (see Table). Sediment P release is a declining residual left over from the 1960s when Issaquah sewage and dairy waste were discharged to the lake. Such gradual, long-term recovery is common in previously sewage polluted lakes. The stable surface water quality over the past 30 years may be partly due to reduced sediment P release, as well as to restrictions on development.

Means (and standard deviations) of total phosphorus (TP) concentrations ($\mu\text{g/L}$ or ppb) in Lake Sammamish at station 612 during two time periods and portions of the lake's volumes. Data from King County.

| | 1981-1994 n = 14 | 1995-2011 n = 17 |
|---------------------------------------|---------------------|---------------------|
| Annual whole lake | 18.4 \pm 2.2 | 17.4 \pm 2.2 |
| Summer hypolimnion (15m to bottom) | 26.9 \pm 9.6 | 20.9 \pm 4.5 |
| Summer epilimnion (surface to 10m) | 12.3 \pm 2.8 | 11.5 \pm 2.3 |